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Geographic factors associated with SARS-CoV-2 prevalence during the first wave - 6 districts in Zambia, July 2020

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factors and SARS-CoV-2 prevalence in Zambia.

Methods We did a cross-sectional study of SARS-CoV-2 prevalence in six districts in July 2020, which was during the upslope of the first wave in Zambia. In each district, 16 Standard Enumeration Areas (SEAs) were randomly selected and 20 households from each SEA were sampled. The SEA PCR prevalence was calculated as the number of persons testing PCR positive for SARS-CoV-2 in the SEA times the individual sampling weight for the SEA divided by the SEA population. We analysed SEA geographical data for population density, socioeconomic status (SES) (with lower scores indicating reduced vulnerability), literacy, access to water, and sanitation, and hygiene (WASH) factors. Gaussian conditional autoregressive (CAR) models and Generalised estimating equations (GEE) were used to measure adjusted prevalence Ratios (aPRs) and 95% confidence intervals (CIs) for SARS-CoV-2 prevalence with geographical factors, after adjusting for clustering by district, in R.

Results Overall, the median SARS-CoV-2 prevalence in the 96 SEAs was 41.7 (Interquartile range (IQR), 0.0-96.2) infections per 1000 persons. In the multivariable CAR analysis, increasing SES vulnerability was associated with lower SARS-CoV-2 prevalence (aPR) = 0.85, 95% CI: 0.78–0.94). Conversely, urban SEAs and poor access to WASH were associated with a higher SARS-CoV-2 prevalence (aPR = 1.73, 95% CI: 1.46–2.03, No soap: aPR = 1.47, 95% CI: 1.05–2.05, households without piped water: aPR = 1.32, 95% CI: 1.05–1.65, 30 min to fetch water: aPR = 23.39, 95% CI: 8.89–61.52). Findings were similar in the multivariable GEE analysis.

Conclusions SARS-CoV-2 prevalence was higher in wealthier, urban EAs, with poor access to WASH. As this study was conducted early in the first wave could have impacted our findings. Additional analyses from subsequent

Background

In the univariable CAR model, the most significant association was observed for areas where it took 30 min to fetch water (PR = 3.72, 95% CI: 1.94–7.14). The lack of soap at home (PR = 1.24, 95% CI: 0.89–1.74) and urban residency (PR = 1.12, 95% CI: 0.94–1.34) were nearly significant. Conversely, the GEE model identified urban residency as a significant factor (PR = 4.80, 95% CI: 2.01–11.44) and shared toilet facilities showed a substantial association, though with high variability (PR = 8.89, 95% CI: 1.11–70.83). The need to fetch water for 30 min also displayed a strong association in the GEE model (PR = 35.38, 95% CI: 0.15-8352.03), albeit with extreme uncertainty (Table 1).

In the multivariable CAR model, higher soesiden>BDC ( )Tj E

these SEAs were randomly selected, districts were purposefully selected. Additionally, SARS-CoV-2 prevalence data was collected over a few weeks and thus reflects prevalence estimates then. The district-specific geographical factors collected from GRID 3 were based on the 2018 Demographic Health Survey and the distribution of these factors may have changed since then. We are limited by the geographical factors available and couldn't look at other ones of interest, such as Household size or health care utilization.

Conclusion

SARS-CoV-2 prevalence was associated with urbanicity, high socioeconomic status and poor access to WASH during the peak month of the first wave in July 2020. Zambia might focus surveillance and response activities on urban population centres and ensure adequate provision of WASH earlier in a wave to mitigate COVID-19 spread.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-21347-w.

Supplementary Material 1

Acknowledgements

We thank the Ministry of Health, Zambia, for providing SARS-CoV-2 prevalence data in Zambia. We thank Zambia Data Hub for providing geographical data. This work was funded by the CDC Emergency Response to the COVID-19 pandemic and the US President's Emergency Plan for AIDS Relief through the US Centers for Disease Control and Prevention (CDC). The findings and conclusions are those of the authors and do not necessarily represent the official position of the CDC.